A Yardstick for Laboratories:
Initial Results from the Labs21 Benchmarking Project

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Benchmarking Project Goals

- Standard set of energy performance metrics
  - Developed Jan 2002
- Data collection and analysis
  - EPA & DOE labs
  - Labs21 pilot partners
  - Labs21 case studies
- Web-based database tool
  - Web prototype developed
  - Model-based benchmarking under development

LABS FOR THE 21ST CENTURY

Metrics

System	Energy Use Metrics	Efficiency Metrics
Ventilation	kWh/sf-yr	Peak W/cfm Peak cfm/sf (lab) Avg cfm/peak cfm
Cooling	kWh/sf-yr	Peak W/sf Avg kW/ton Peak tons/sf
Lighting	kWh/sf-yr	Peak W/sf
Process/Plug	kWh/sf-yr	Peak W/sf
Heating	BTU/sf-yr	
Aggregate	kWh/sf-yr (total elec) BTU/sf-yr (site, source)	Utility $/sf-yr Peak W/sf Effectiveness (Ideal/Actual)

Metrics

- Normalizing Parameters
  - Building Area
  - Lab Area
  - Weather
  - Process loads
  - Lab type
  - Occupancy hours
  - Indoor conditions – temperature, humidity, vent rate

Data Collection

- Developed Excel Template
  - Prioritized data
- Data from 25 Lab facilities
  - ~6 with detailed data
  - 17 federal facilities
  - 12 organizations
  - Geographically distributed
  - Mostly chem/bio

Labs21 Benchmarking Database
Data Collection Form v0.1

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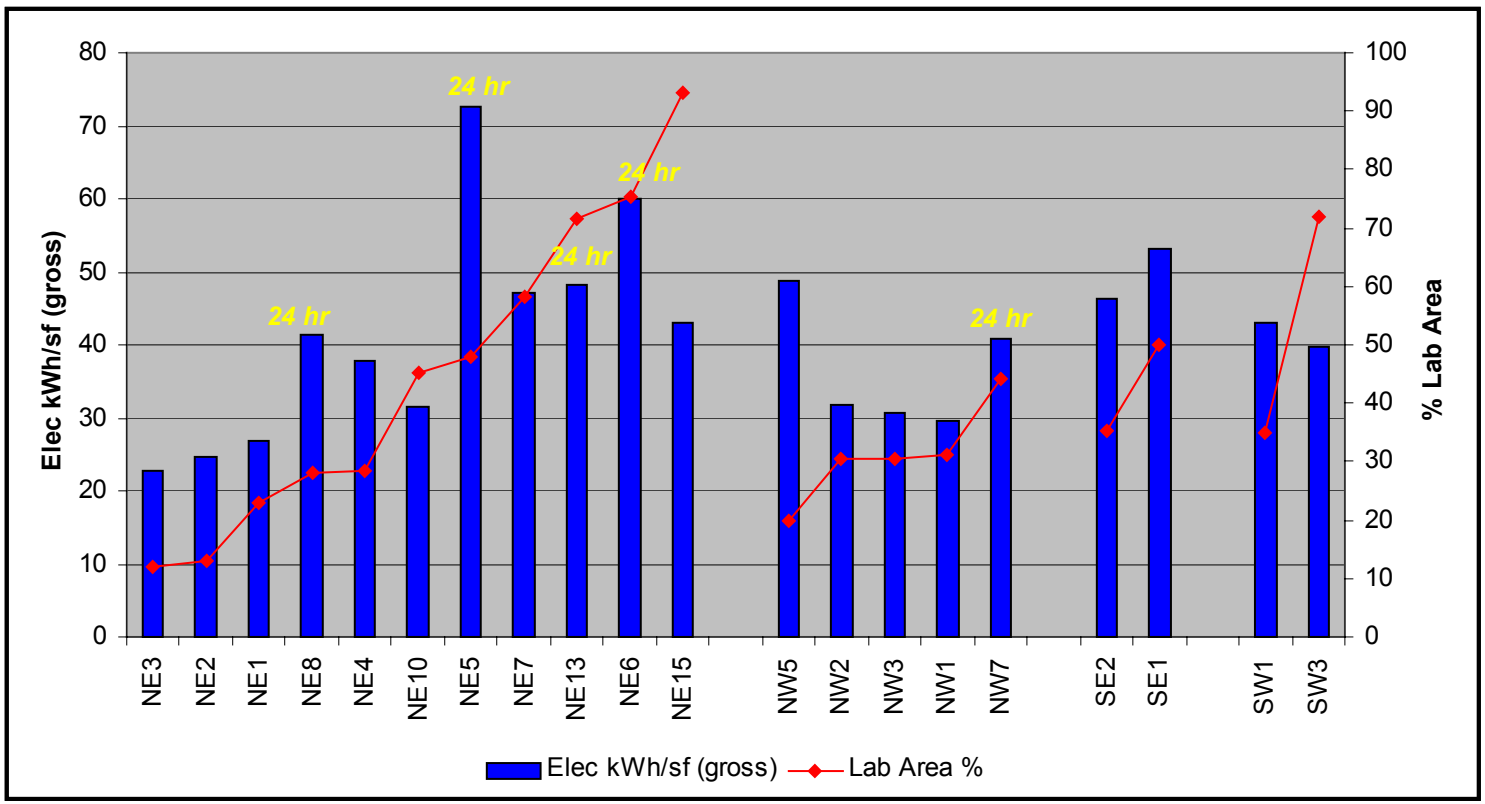
* Priority 1 Data
* Priority 2 Data
Priority 3 Data

		Value	Comment/Explanation
	General Facility Data		
*	Facility Name	Fred Hutchinson Cancer Research Center	
*	Street Address	1100 Fairview Ave.	
*	Location	Seattle, WA	
*	ZIP Code	98109	
*	Lab Use	Research/ Development	
*	Lab Type	Biological	
*	Lab Category	Wet Lab	
*	Number of Buildings	3	Phase 1 has 2 bldgs, and phase 2 has 1 bldg
*	Gross Area (sq.ft)	532,602	
*	Lab Area (sq.ft)	105,665	
	Weekday Occupancy Hours	11	8 am to 7 pm is regarded as "occupied hours"
	Year built	1997	phase 1 in 1993, phase 2 in 1997
	Energy Use Data		
*	Annual Energy Utility Costs ($)	1,390,091	$2.61/ gross sf (utility bill data)
*	Ann. Heating Energy (therms)	963,667	utility bill data
	Does facility use CHP (Cogen) system?		
	Annual Electricity Use (kWh)		
*	Total building(s)	41,010,354	based on design data, actual for 2000-2001 was 25,937,717
*	Ventilation	19,067,152	based on design data
*	Cooling Plant	4,686,898	based on design data
	Lighting	3,408,653	based on design data
	Process/plug	13,847,652	based on design data
	Peak demand (kW)		

Annual Electric Energy Use

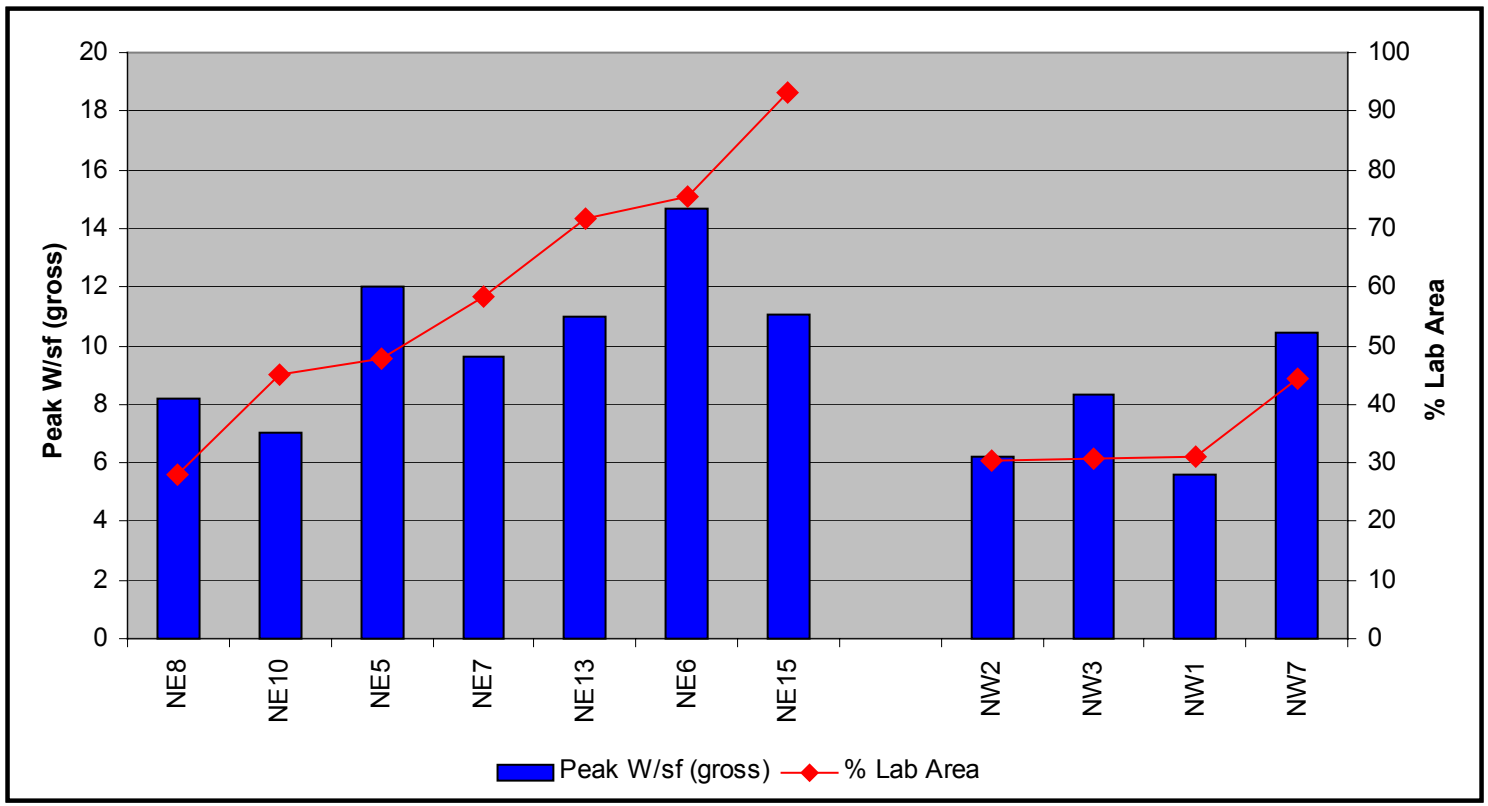
Sorted by climate zone, lab area %



LABS FOR THE 21ST CENTURY

Peak Load

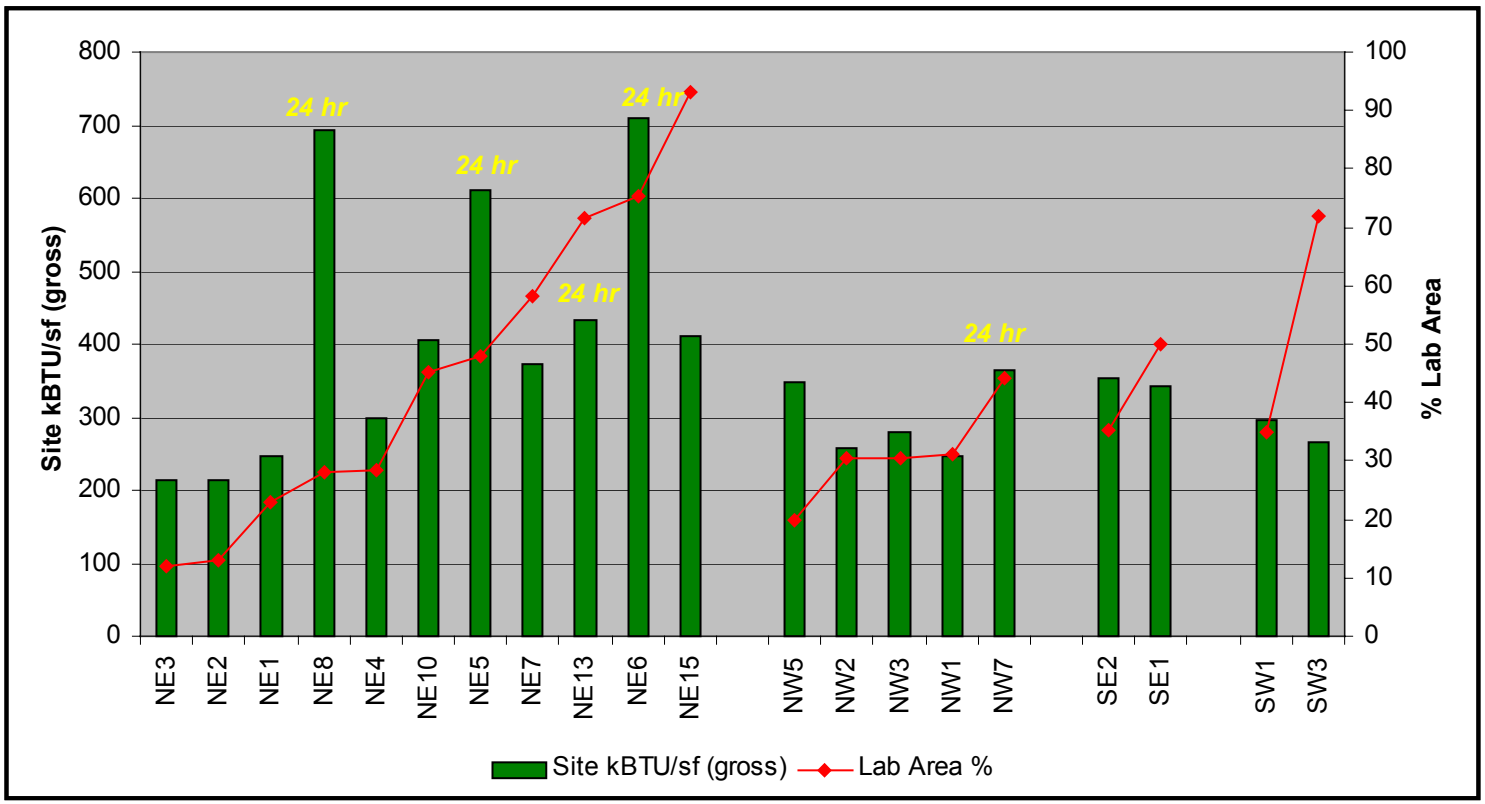
Sorted by climate zone, lab area %



LABS FOR THE 21ST CENTURY

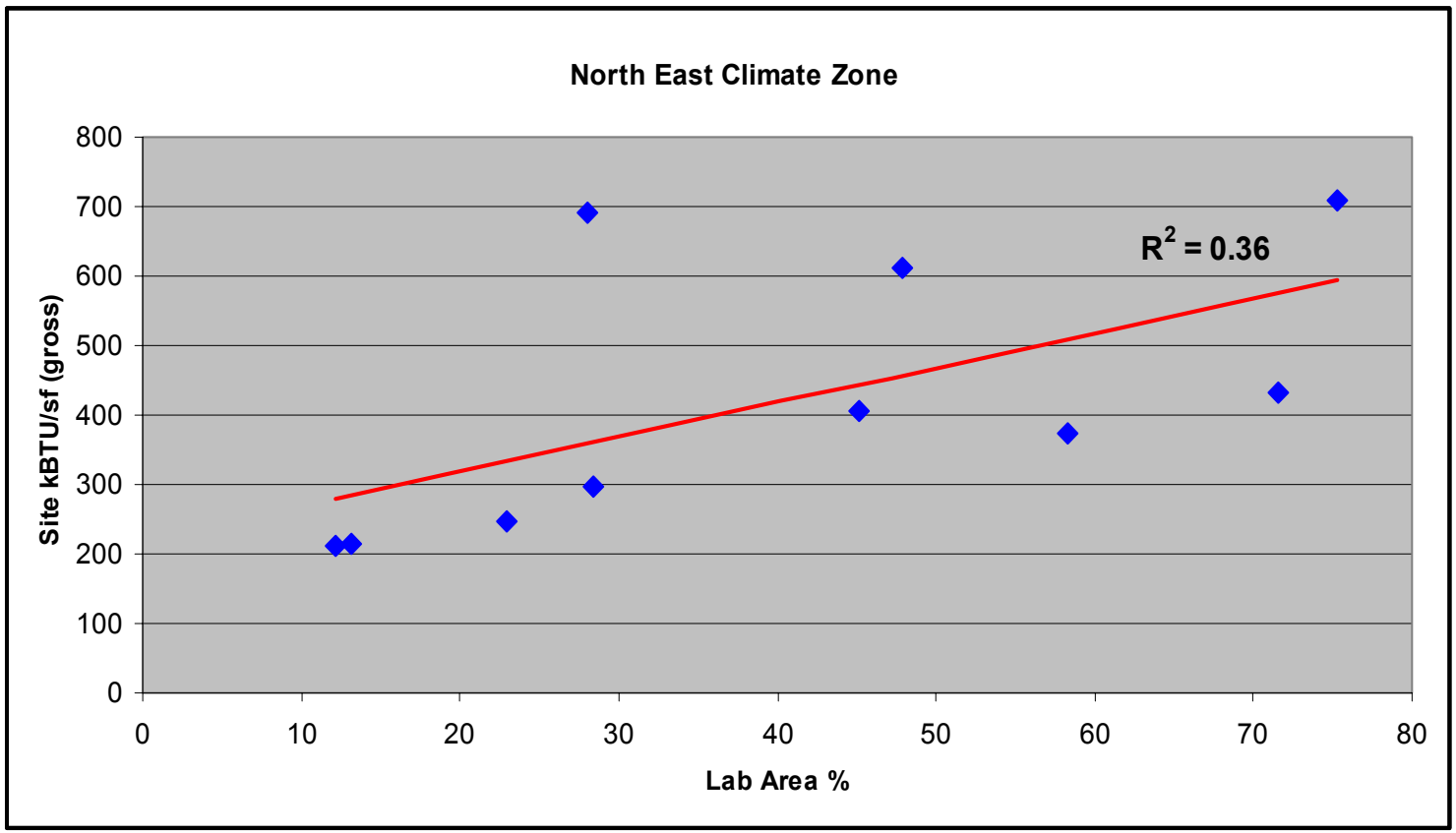
Annual Site Energy use

Sorted by climate zone, lab area %



LABS FOR THE 21ST CENTURY

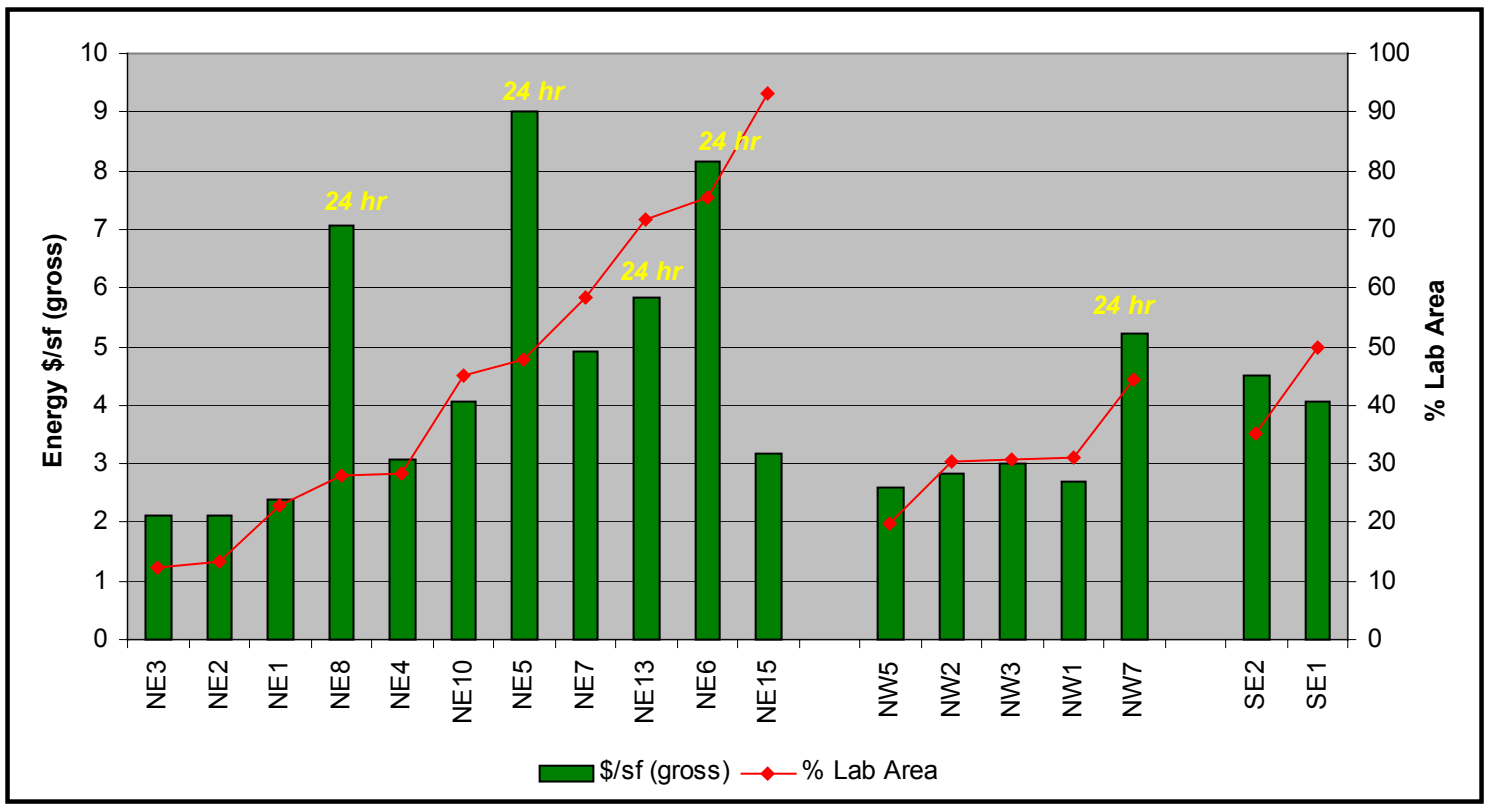
Lab Area % and Energy Use



LABS FOR THE 21ST CENTURY

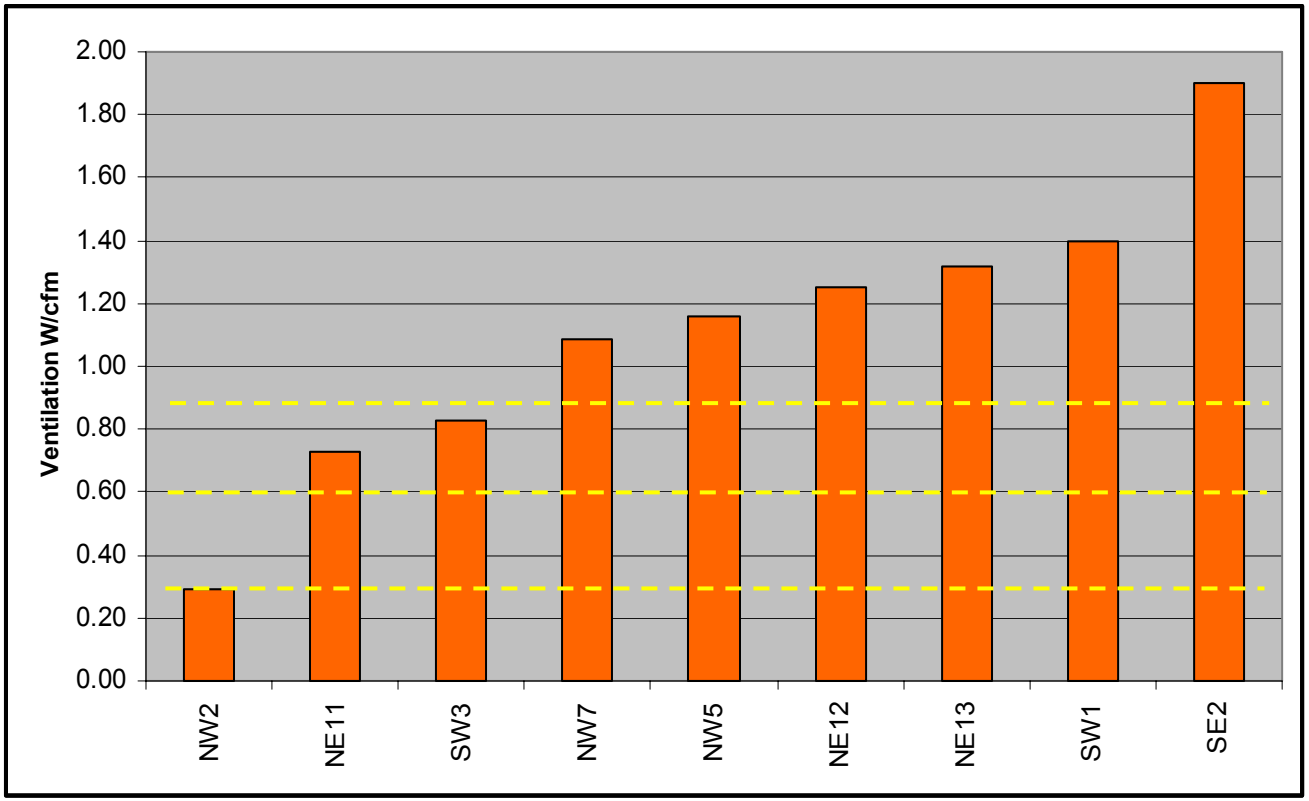
Annual Energy $/sf

Sorted by climate zone, lab area %



LABS FOR THE 21ST CENTURY

Ventilation W/cfm

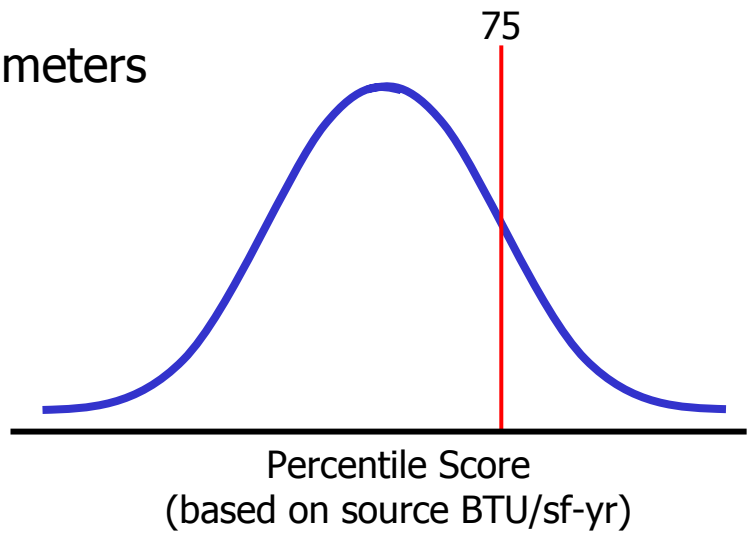


Standard, good, better benchmarks as defined in
"How-low Can You go: Low-Pressure Drop Laboratory Design"
by Dale Sartor and John Weale

LABS FOR THE 21ST CENTURY

Benchmarking Options…1

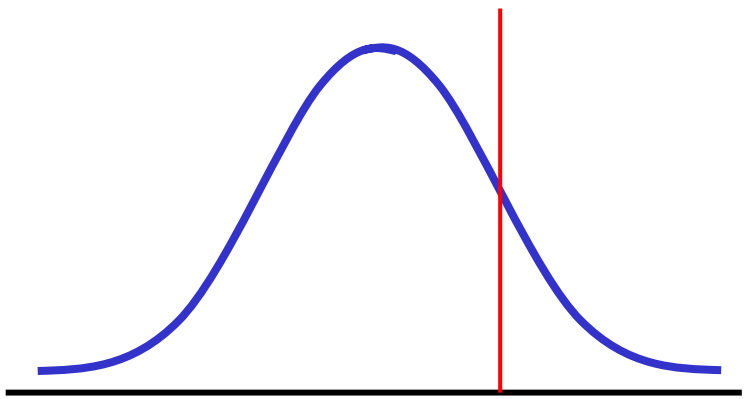
- Statistical benchmarking
  - Used in EnergyStar
  - Difficult in Labs
    - Too many normalizing parameters
    - Small sample sizes
    - Could be used for some system metrics



LABS FOR THE 21ST CENTURY

Benchmarking Options…2

- Model-based benchmarking
  - Use analytical model to determine "ideal"
  - Energy Effectiveness = Ideal/Actual (0 < 1)



Energy Effectiveness

LABS FOR THE 21ST CENTURY

Model Based Benchmarking

- Model Inputs (normalizing parameters)
  - Location (weather)
  - Building area
  - Lab area
  - Occupancy schedule
  - Required indoor conditions (temp, humidity, vent rate)
  - Process and plug load
    - Lower of measured or standard values (based on lab type)

Next Steps

- Complete web tool
  - Data collection
  - Basic data analysis and graphing
- Develop benchmarking model
  - EnergyPlus vs. DOE-2 vs. Other?
  - Integrate with web tool